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Introduction to the Rarer Elements. By PHILIP E. BROWNING. Third edition, thoroughly revised. New York, John Wiley & Sons. 1912. Pp. xii + 232.

Our knowledge of the rarer elements has been considerably extended since 1908, when the second edition of "Browning" appeared.

While the general scheme of the work remains the same as in the two previous editions, the author has made many changes and additions throughout: for instance, the chapter on qualitative separation has been extended by including new analytical diagrams, working directions, and notes; the chapter on technical applications has been much improved by the addition of considerable material; and a table of spectroscopic lines and plates illustrating typical spectra have been added. The revision has been quite thoroughly done. For the first time the work has been well indexed; this improvement in itself greatly enhances the usefulness of the book.

Among the omissions may be noted the following: The test for the platinum metals (except osmium and ruthenium) devised by Curtman and Rothberg (this is the most delicate chemical test for platinum); and the conduct of the platinum metals toward various gases (Phillips, *Am. Phil. Soc.,* March 17, 1893).

It would be advisable in later editions to give the original references to the literature on technical applications, especially to the patents; and to include a complete bibliography of the treatises on the rarer elements, if any bibliography is given.

CHARLES BASKERVILLE

Light, Photometry and Illumination. A thoroughly revised edition of "Electrical Illuminating Engineering." By WILLIAM EDWARD BARROWS, Jr., B.S., E.E., Professor of Electrical Engineering, University of Maine. New York, McGraw-Hill Book Company. 1912. Pp. ix + 335.

Some of the science, and most of the art, of illumination is still in a decidedly unsettled state, and he who wishes to write a text-book on the subject has a narrow course to sail between the Scylla of obsolescent matter and the Charybdis of controversial discussion. Professor Barrows apparently has more fear of the first danger; at any rate, he has in several parts of his new text gone perilously near to the second. A considerable part of the book is made up of quotations and passages adapted from recent papers. As a résumé of important articles of the last few years the work is useful, and its value is augmented by the care which has been taken to give references to the original authorities. By copious use of quotations the author to some extent disarms criticism and shifts responsibility to the original authors, but for purposes of instruction the book would be more valuable if some of the lengthy quotations were replaced by a digested presentation of the problems to be met and the facts supposed to be established.

The treatment of radiation which serves as an introduction to the book is characterized by a looseness of expression which can not fail to produce hazy ideas in the mind of the student. As examples may be mentioned the statement that "at wave-lengths greater than those of red light the energy radiated is in the form of heat" (p. 1), and the naïve criticism of the bolometer because it "is apt to indicate the heat rays rather than the luminous rays" (p. 93).

Even more serious are certain misstatements of fact, *e. g.,* "since the radiation varies as the fourth power of the temperature, it is evident that the greatest efficiency of radiation will be obtained at the highest temperatures," and "it follows from the above that the efficiency of the source as an illuminant will vary greatly with the temperature" (p. 4). These statements precede any mention of the real cause of the increase in efficiency, that is, the shifting of the radiation toward shorter wave-lengths with rise of temperature.

The discussion of the Luminous Equivalent of Radiation in Chapter III. is anything but clear. Its vagueness is due in part to the promiscuous use of terms without definitions,

but one can hardly avoid the conclusion that the author himself had no very sharply cut ideas associated with the various terms. It is to be regretted that the table of "reduced luminous efficiencies" taken from Ives is not accompanied by a quotation to explain the significance of this important conception and its relation to the older ideas of luminous efficiency and the mechanical equivalent of light.

On page 64 the statement is made that Houstoun's and Strache's specifications of a standard of illumination in terms of radiation having a spectral distribution corresponding to the sensibility curve of the normal eye "consist in specifying the light standard by the least quantity of radiated energy which can produce the standard intensity." This is not true, and the error is especially striking because immediately preceding it is a whole page of discussion of "the most efficient possible radiation" as the basis of the Ives standard.

It should be noted that the luminosity curves given on pages 42 and 98 are not in the form at present accepted, since they were plotted from Koenig's data without correction for the dispersion of his prism. Incidentally the ingenious hypothesis of Dr. Bell that errors in heterochromatic photometry with the equality of brightness photometer are due to "the shifting of colors by contrast along the luminosity curve" can not be considered so well established as the author seems to think.

In view of the importance of the relation of the old English candle to the international candle now generally accepted as the unit of intensity in England and France as well as the United States, it is unfortunate that Professor Barrows has felt it necessary to give a new value for the old unit (p. 61) and has thus helped to perpetuate the mistaken impression that the value of the English candle has been intentionally changed. The fact is that the present unit is exactly the same as the old English candle to the degree of accuracy with which the British authorities could determine the proper average value of the old unit. Since there have been no British standard sperm candles made under authority of law since 1898, and the German candle was superseded by the Hefner 25 years ago, it is to be hoped that makers of text-books will some time accept the simple ratios of units now in use and will cease to give confusing tables of uncertain historical ratios.

The middle portion of the book gives descriptions of a great variety of photometrical apparatus and a very complete exposition of various methods of calculating light flux and illumination. A number of tables summarize the published empirical data of the best-known illuminating engineers and are valuable as an approximate indication of the results to be expected from various types of illuminants and methods of installation. In an appendix are given several tables of constants which are useful in the calculation of illumination.

Two chapters devoted to principles of interior and of street illumination are largely quoted from papers of Mr. A. J. Sweet. Of 22 pages dealing with street lighting, 17 are copied verbatim. Since Mr. Sweet's papers were not intended to be text-books, it is no disparagement of his work to say that the chapter covers the subject very inadequately. That the opinions so fully quoted are not universally accepted is shown in a curious way. Mr. Sweet takes twelve pages to establish the conclusion that an angle of about 65° from the vertical "must be taken as a line of absolute prohibition" for high intensity in street lamps. "If it is to be exceeded at all, it may as well be entirely ignored," he says, and on the opposite page Professor Barrows gives a curve for a lamp which has 75 per cent. of its maximum candle-power as high as 80° from the vertical, with the statement that it "closely approximates the ideal conditions"!

The book as a whole would have been much improved by a thorough editing, for in many passages the language is crude, to say the least. It is marred also by an unusual number of typographical errors. Nevertheless, in spite of the many weak points, it must be granted that Professor Barrows has collected a large amount of valuable material, and it is to be hoped that future editions will enable

him to remedy defects both of form and of substance.

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SPECIAL ARTICLES

THE EFFECT OF ANESTHETICS UPON PERMEABILITY

THERE is much uncertainty as to the mode of action of anesthetics and particularly as to their effect upon permeability. While some writers hold that anesthetics increase permeability, others take the opposite view.[1] To clear up this confusion appears to be a necessary step toward a theory of anesthesia.

A definite solution of this problem seems to have been attained in the cases here described. This result is due to the employment of quantitative methods without which it would not have been possible.

The experiments were made by measuring the conductance of living tissues of a marine plant, *Laminaria*. Under the conditions of the experiment an increase or decrease of conductance signifies a corresponding increase or decrease of permeability.[2]

The anesthetics were mixed with sea water and sufficient concentrated sea water was then added to make the conductivity equal to that of sea water. The material was then placed in the mixture and its conductance was measured at frequent intervals.

Material having resistance of 1,000 ohms[3] was placed in a mixture of 990 c.c. sea water plus 10 c.c. ether, to which was added sufficient concentrated sea water to make its conductivity equal to that of ordinary sea water. In the course of 10 minutes the resistance rose to 1,100 ohms: in the next 10 minutes it fell to 1,070 ohms; in 20 minutes more to 1,020 ohms, and in 20 minutes more to 1,000 ohms. In the next 20 minutes it dropped to 990 ohms, at which point it remained stationary for a long time. Subsequently it decreased very slowly, but at exactly the same rate as the control which remained in sea water during the experiment. After 24 hours it had the same resistance as the control.

In order to find out approximately what part of the resistance is due to the living protoplasm the tissue was killed at the end of the experiment by adding a little formalin: after rinsing well in sea water the resistance was 320 ohms. This represents the resistance of the apparatus and dead tissue; on subtracting it from the resistance previously given we obtain approximately the resistance due to the living protoplasm. This may be called the *net resistance* while the resistance before subtraction may be called the *gross resistance.* In this experiment, therefore, the net resistance before treatment with ether was $1,000 - 320 = 680$ ohms and the net conductance $1 \div 680 = .00147$ mho. The loss in net conductance due to ether is 13 per cent., which means a decrease of permeability amounting to 13 per cent.

It is evident that this decrease of permeability is completely reversible and involves no injury. The fact that after the resistance has fallen to a stationary point it is 10 ohms below the starting point does not indicate injury, but only an increase in the conductivity of the solution due to the evaporation of the ether.

In another series of experiments the effects of the evaporation of the anesthetic were avoided by constantly renewing the solution by means of a steady current. It was then found that the resistance, after rising rapidly to a maximum, remained stationary for a long time (often for two hours or more) at the maximum point, afterward falling slowly to the normal. This more prolonged exposure to the anesthetic seemed to produce no injurious effects.

In these experiments the amount of ether in the solution was 1 per cent. by volume. Smaller amounts of ether produced less effect:

[1] Cf. Höber, "Physikalische Chemie der Zelle und der Gewebe," Dritte Auflage, 1911, pp. 219, 223, 489; R. Lillie, *Am. Jour. Physiol.*, 29: 372, 1912; 30: 1, 1912; Lepeschkin, *Ber. d. bot. Ges.*, 29: 349, 1911.

[2] The method has been described in SCIENCE, N. S., 35: 112, 1912.

[3] All the figures in this paper refer to readings at 18° C.